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Active Landscape - Passive Building: A Design-Build Case Study

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Active Landscape — Passive Building: A Design-Build Case Study is a design-research project sited in a vast agricultural landscape in Huron County, Ontario Canada. Early site investigations and fieldwork measured the wind patterns, crop growth, and landfall on the site in order to merge a quantitative and qualitative understanding of environmental exchanges operating on the twenty five acre site. This understanding facilitated a siting and design strategy that maximises opportunities for passive heating and cooling within the extreme annual climatic conditions of rural Ontario. As a design-build project, research also investigated techniques for community engagement during construction. By working with local farmers in the capacity as builders/sub-contractors, the design developed around a series of construction and material practices that both adopted from and challenged its cultural context.

project

Active Landscape — Passive Building: A Design-Build Case Study

output 1

Lisa Moffitt

ESALA

Edinburgh School of Architecture & Landscape Architecture

project introduction

Project Description

Active Landscape — Passive Building: A Design-Build Case Study is a design-research project sited in a vast agricultural landscape in Huron County, Ontario Canada. Early site investigations and fieldwork researched the following: What low-tech full scale site analysis techniques merge both a quantitative and qualitative understanding of environmental exchanges operating on the twenty five acre site? How might this full scale site analysis facilitate a siting strategy that maximises opportunities for passive heating and cooling within the extreme annual climatic conditions of rural Ontario?

In addition to developing techniques to facilitate environmental performance, research honed techniques for community engagement during construction. The house was a design-build project completed for an elderly client on a limited budget. By working with local farmers in the capacity as builders/sub-contractors, the design developed around a series of premises that both adopted from and challenged its cultural context. The construction process investigated the following research questions: How does direct engagement with the local community during construction facilitate appropriation of cultural values of thrift and simplicity and build on vernacular building strategies and material practices? In this exchange, what might the architect offer as an alternative to local trends in 'upsized' residential construction?

Conversation 1: Environmental Exchange

Over the course of two years, the author completed extensive full scale site studies to research the cultural and environmental context of the site. In the most extensive investigation, a grid of 100 3 meter tall steel poles were installed on the site using a surveyors transit. These poles became station points from which topographic and wind data was measured and observed throughout the year. This study facilitated a nuanced understanding of topography as a dynamic condition reflecting seasonal shifts tied to crop growth and weather patterns.

The house is strategically sited in response to this nuanced understanding of aerial and terrestrial topography. Sited on the edge of a topographic dip, it resists and redirects harsh westerly winter wind over its sloped shed roof. An extended south shed cantilever overhang blocks harsh summer sun while allowing winter sun to passively heat thermal mass of the concrete floor. Evenly distributed north and south windows facilitate cross ventilation. The house is off-grid and infrastructure is limited to a small footprint on the site, increasing its sense of autonomy. Passive heating and cooling strategies outlined above, supplemented with the use of high efficiency appliances, reduce operational energy consumption. Electricity is provided by a 1.4 kw array.

Conversation 2: Cultural Exchange

Conversations about sustainability focus on the triple bottom line: how a project balances social, environmental and economic concerns. Addressing environmental and economic concerns are standard practice for architects. It is more difficult to engage in depth in the social dimensions of local construction practice and the corresponding implications of on the ground of decisions typically made by the general contractor. By moving to the site and involving the local community in construction, the process of building the house facilitated a cultural exchange that informed material selection and construction methods while also introducing the community to novel energy-saving construction practices.

Strangely familiar in form due to its reappropriation of barn typologies, the house also critiqued and offered an alternative to energy-intensive existing tract-home building methods in the region. Daily exchanges with local subcontractors, often farmers with side trades, honed particular building strategies, techniques for construction, and material selection that built from local knowledge. The house was flat-framed and lifted in place using a process akin to a local barn-raising, a common building practice within the local Mennonite community. Through word of mouth, small local materials and suppliers were sourced. Agricultural materials and implements were inventively recycled and/or reappropriated.

Recognition

The house has been recognised locally, nationally and internationally: The Ontario Association of Architects presented the project as the first case study of exemplary sustainable design on their professional website. The OAA is the professional governing body of architects in Ontario with 5,000 members. The project was featured with a 5 page review in Dwell magazine, with a readership of 330,000. It was selected by HISE, Slovenian Design Journal, as one of the best homes of 2013 and was subsequently exhibited in Ljubljana. It was the cover feature of the international design tablet magazine Edition 29, which includes designer audio overviews. The project has featured on websites: ArchDaily, the most widely read architecture website in the world, Dezeen, inHabitat, Archilenta (in Russian), Thisispaper, the Ruralist, Treehugger, ARQA (Argentinian), and Architizer. Associated research has been integrated into the curriculum of two Universities in Canada: it is a sustainability case study project / site visit for students of Ryerson University. Fanshawe College in London, Ontario included a video interview with the author as part of their 2013 'Applied Sustainability' MOOC.

project
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output 1
Lisa Moffitt

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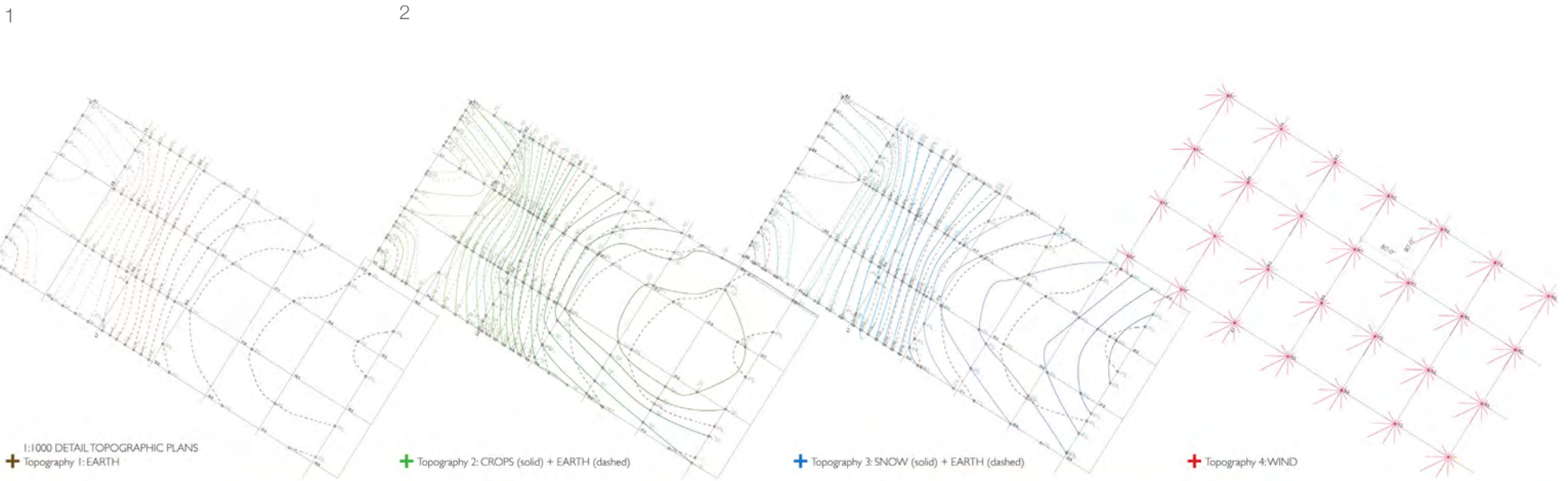
What low-tech full scale site analysis techniques merge both a quantitative and qualitative understanding of environmental exchanges operating on the twenty five acre site?

Snow drifts in winter and the growth and cultivation of crops in Spring, Summer and Autumn ensure that there is no single enduring topography on the site. An early fieldwork study establishes a metric on the site in order to better understand these shifting environmental topographies. Using a surveyor's transit, a grid of approximately one hundred 2.75 m high repurposed steel poles spaced 24 m apart was installed on the site. Each pole, outfitted with a windsock for tracking wind patterns, became a station point from which the multiple site topographies were measured throughout the year. Drawn as a series of variable topography drawings, the investigation honed an understanding of the environmental nuances of the site that come through sustained exposure and observation of place.

- 1 Windsocks visually register global wind conditions on the site.
- 2 The grid establishes a metric for measuring aerial and terrestrial topographies.
- 3 Seasonal topographies were measured as spot elevations at each pole and registered in relation to the base ground topography through drawing.

"In the years following the American Revolution, thousands of Loyalists moved north into Ontario, Canada. Governor John Graves Simcoe sent out surveyors to divide up Southern Ontario with a super-grid of lines and concessions that came to define the landscape, as the land was cleared for farmland. The House on Limekiln Line is an extraordinary artifact, addressing this 220 year old heritage, yet is so completely modern...the house is "off grid" but in fact there have been few houses anywhere that were more on grid. Five years ago Lisa studied every square meter of it."

Lloyd Alter, editor of the Design Section of Treehugger.com, academic at Ryerson University.
<http://www.treehugger.com/slideshows/green-architecture/house-limekiln-line/>



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How did the full scale site analysis facilitate a siting strategy that responds to measured nuanced topographic shifts?

Sited on the edge of the topographic shift measured in the site survey to maximise summer airflow and long site views, the house acts as a datum to this shifting topography. Crops grow right up to the edge of the house, maximising production on the site, which is still an active farm. A continuous west deck walk which is framed through the front/back door allows the occupant to walk within and then above the shifting crops below, facilitating stewardship of the productive landscape.

- 1 Extended seasonal photos capture the shifting meteorologies of the long western view.
- 2 This view is heightened by the framed view into and through the house.
- 3 An extended west deck walk registers the shifting topography and frames the long view.



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How does full scale site analysis facilitate a siting strategy that maximises opportunities for passive heating and cooling within the extreme annual climatic conditions of rural Ontario?

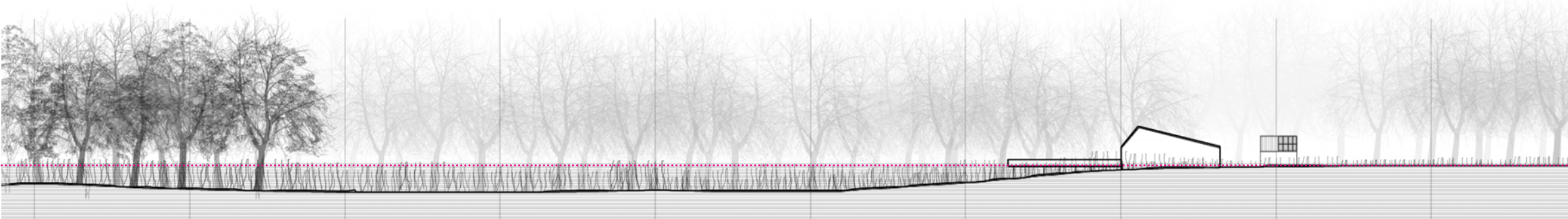
A qualitative understanding of weather patterns is confirmed through a more systematic quantitative site analysis using psychrometric mappings and solar gain simulation studies. Low temperatures and high westerly winds from Lake Huron make underheating a dominant concern winter, autumn and most of spring. Solar gain is a key strategy for passive heating in the winter. Late spring and summer are mild and can be cooled entirely passively through cross-ventilation.

A generous south deck overhang blocks summer sun while allowing winter sun to heat the concrete thermal mass floor. Evenly distributed operable windows facilitate summer cross-ventilation and stack effect heat purging.

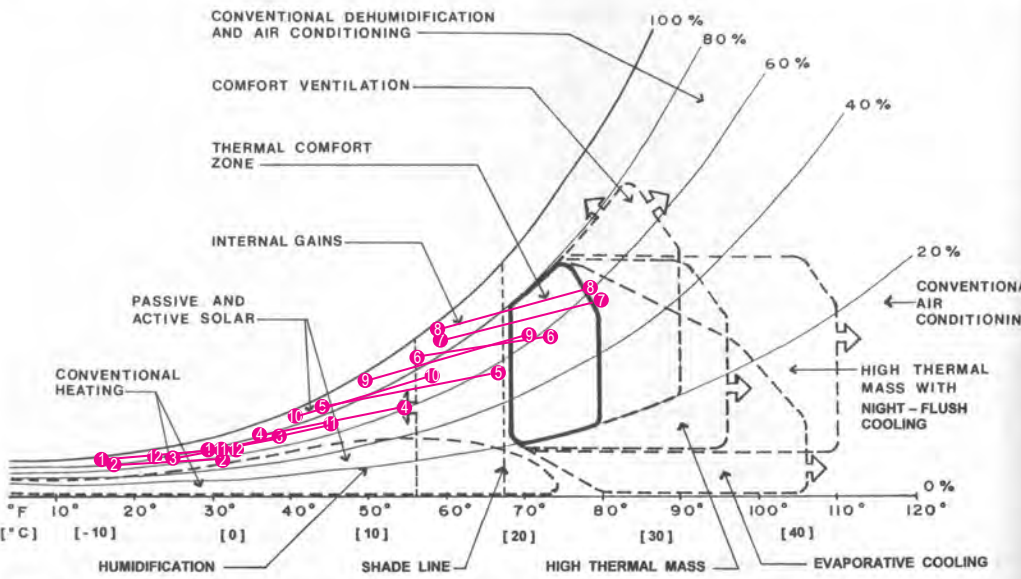
- 1 The house is sited on the edge of the measured topographic shift to maximise summer airflow and long views.
- 2 The psychrometric chart confirms that supplemental active heating is required in winter in addition to passive measures tied to solar gain and thermal mass.
- 3 Digital models simulated solar radiation in order to calibrate the extent and orientation of the south roof overhang to maximise solar gain in winter and minimise it in summer.

I really enjoyed speaking with Maggie Treanor about her home, and it's clear that she was a perceptive and appreciative client. She wrote me this note: "Approaching the house from the south, coming home this afternoon — the date almost the summer solstice — I noticed how the shading provided by the roof pitch over the south deck was as precise as the drawings Lisa had made after researching the sun's elevations and transit at this longitude and latitude across all the seasons. It truly is the attention to all the little detail she understood and her effort to design with these details in mind that makes this place so special in the landscape. It is a house of beauty."

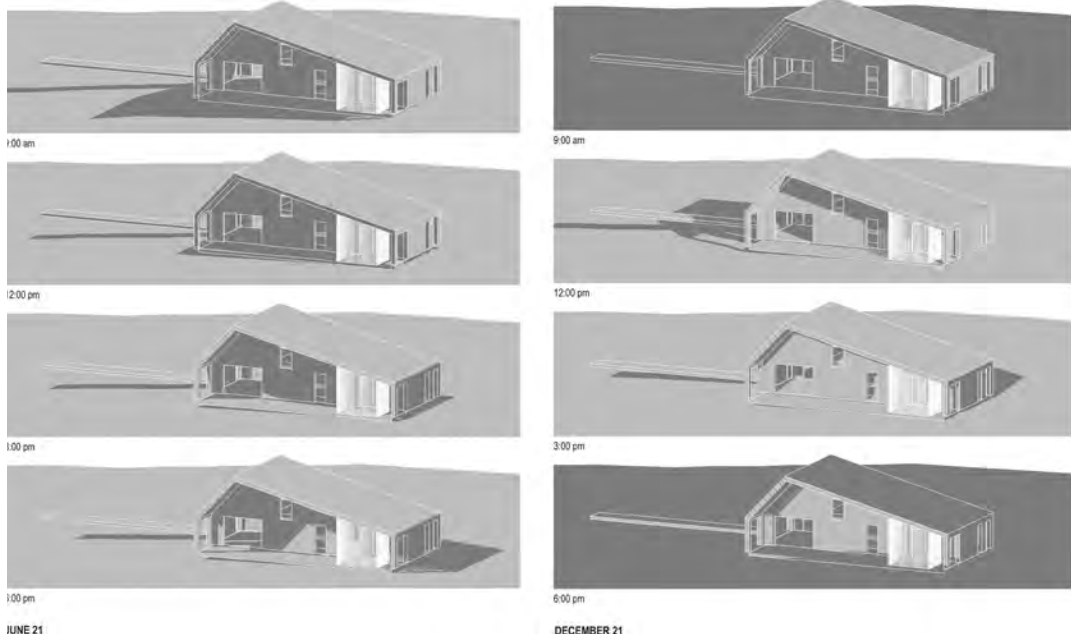
Alex Bozokovic, writer of the Dwell article 'Into the Great Wide Open'
Source: <http://www.nomorecity.net/in-dwell-limekiln-line-house/>



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A range of design strategies minimise operational and embodied energy of the house without compromising experiential connection to the broader landscape.

Early fieldwork studies honed a qualitative understanding of the environmental shifts that take place diurnally and annually on site, and the design of the house facilitates this experiential understanding. The interior of the 85 m2 house is visually expansive despite its limited footprint. All enclosed interior spaces are contained to a central “core” of services. Calibrated views into and through the house allow it to act as a space of observation of the shifting landscape beyond.

- 1 Construction site photo sequence recording extent of solar gain in winter.
- 2 Calibrated views into and through the house ensure that, despite the limited footprint, the house feels expansive and connected to the larger landscape, facilitating stewardship.



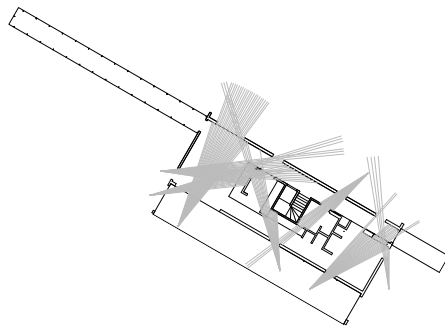
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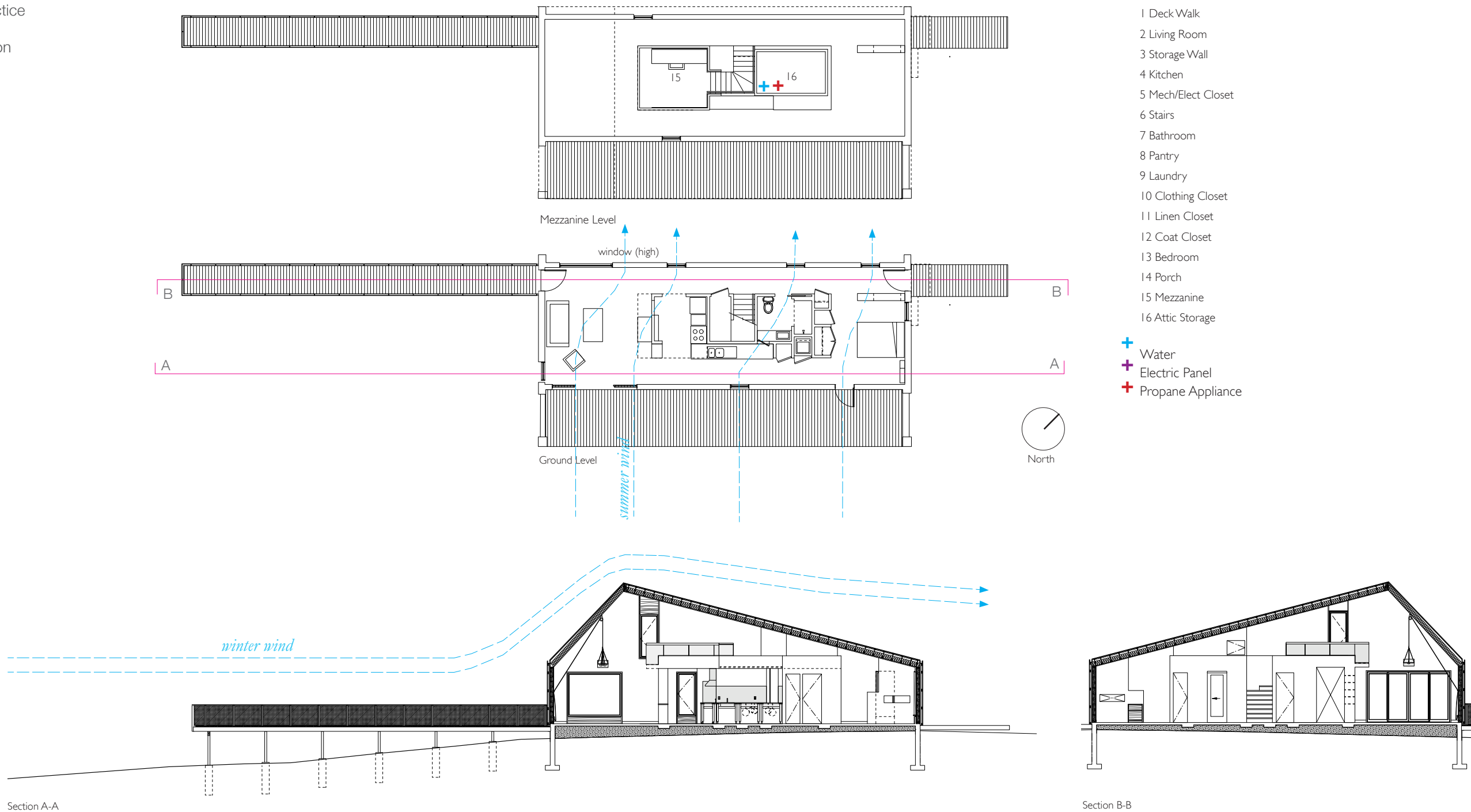
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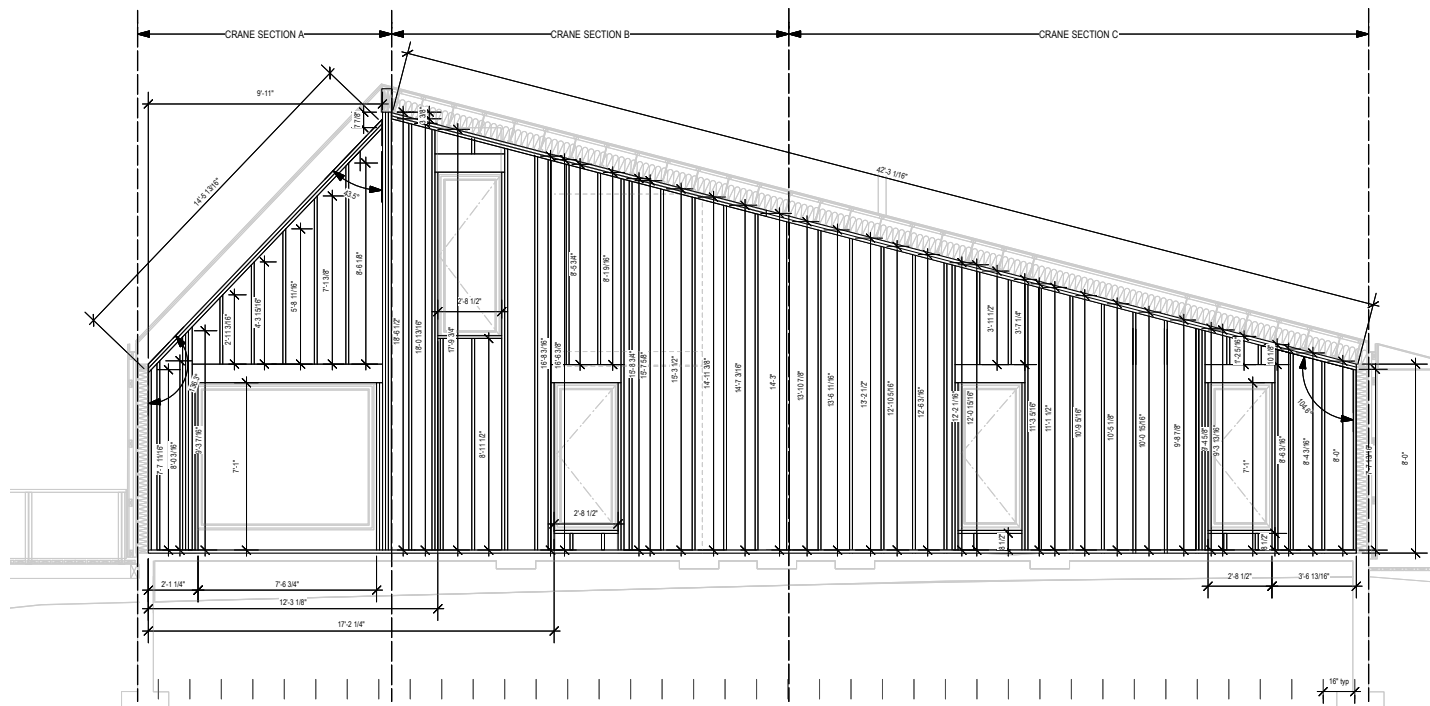


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How does direct engagement with the local community during construction build on vernacular construction and material practices?

Research into local construction processes were honed through close conversations with local farmers who assisted with construction. The architectural language of the exterior, a monolithic galvanised steel shed, is informed by the local barn vernacular to ensure visual coherence within the landscape and to facilitate construction with locally available and sourced materials. Exterior walls were flat-framed on the foundation by a construction crew and then raised in place using the local electrician/farmer's crane. This process was akin to barn raisings that still take place within local Mennonite communities.

- 1 Time-lapse of south wall raising.
- 2 Mennonite barn-raising reference image.
- 3 Braced framed walls.
- 4 Dimensioned framing plan drawn to facilitate precise construction by local builders.
- 5 Attaching the crane bracing to the flat framed wall section.



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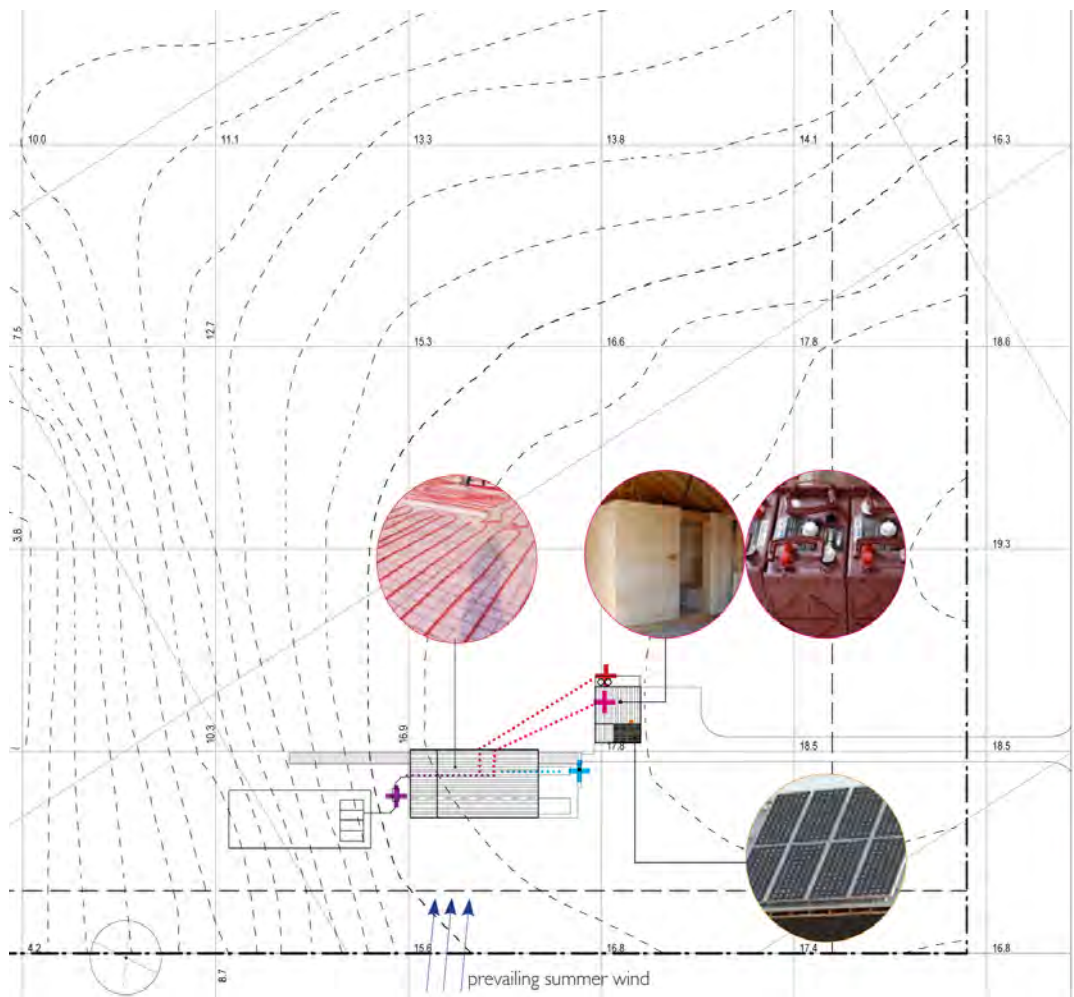
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Siting and orientation of the house and drive shed draw from the environmental and material intelligence of vernacular building practices in the region.

The south facing covered deck moderates solar gain similar to the vernacular brick farmhouses common to the area. The form of the house borrows from the simple monolithic steel and wood sided barns in the area. However, its footprint is intentionally limited.

In such an expansive landscape rich with natural resources, pressure to upsize systems 'for resale value' were resisted. In addition to minimising building footprint, the smallest available heating system, septic bed, and a compact photovoltaic array were installed.

1 Vernacular farm homes typical of the area. The house borrows from passive strategies (thermal mass and porch overhangs) but resists expansiveness.
2 & 3 Vernacular agricultural building.
4 All services are contained on the site and all electricity is produced through a 1.4 kw photovoltaic array.
5 View of completed house and drive shed looking north.

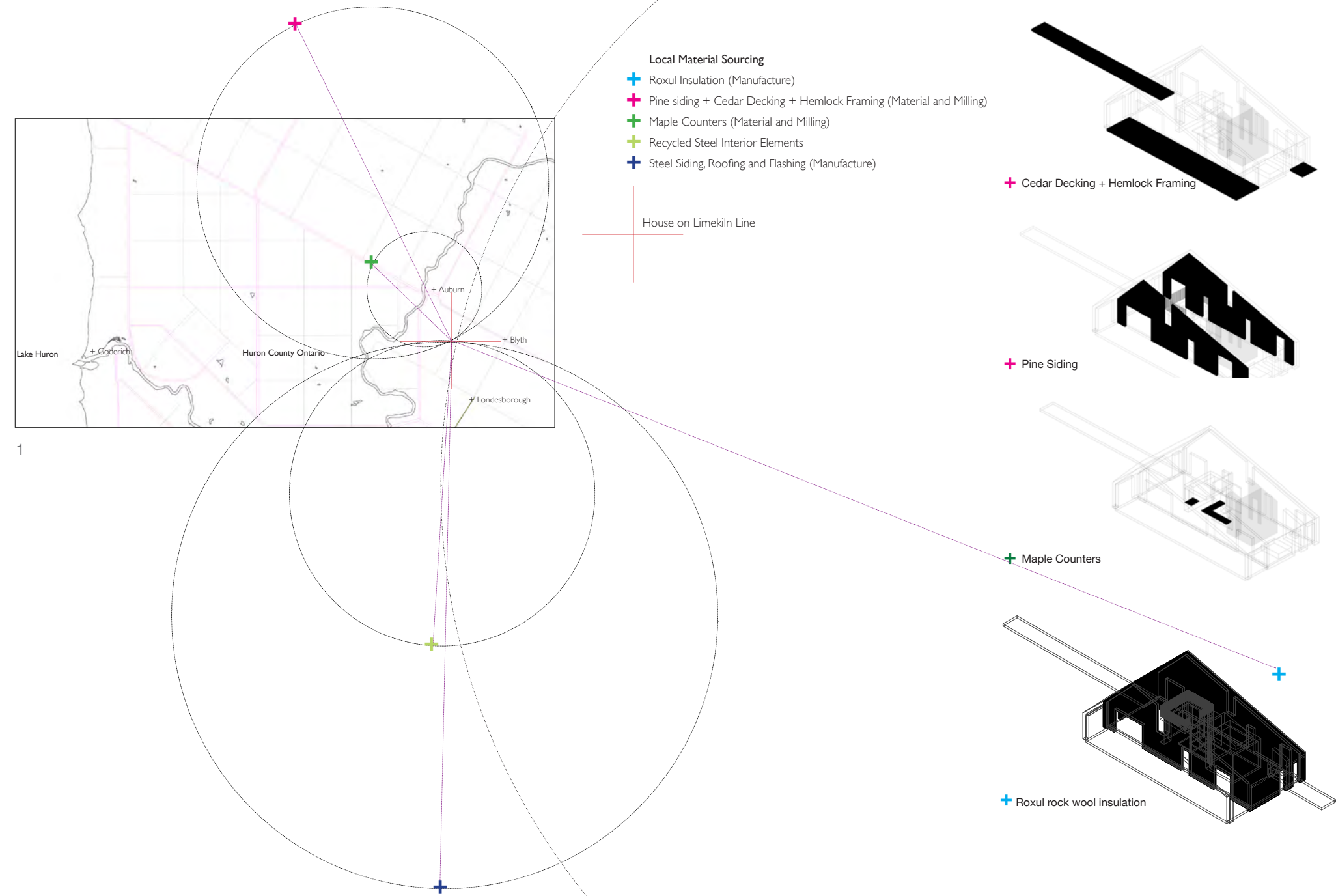


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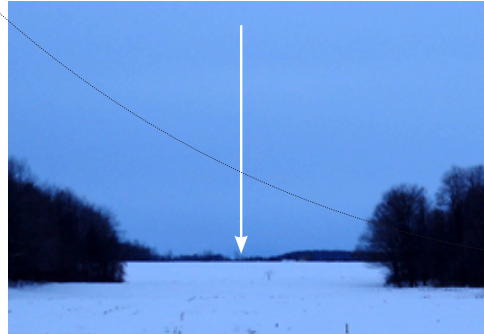
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Being on the ground facilitated word of mouth recommendations of small-scale building suppliers of locally sourced materials. Pine used for siding, hemlock for deck framing, cedar decking, and maple counters were all sourced from a site within view of the lot.

Material economising extended to all stages of construction, including waste disposal. All excess wood (framing and siding) scraps were donated to local farmers for biomass for winter heating. Steel scraps were recycled and gypsum wallboard mulched by the Huron County landfill.

1 Local Material Sourcing Map showing distance from site to source of decking, siding, interior counters, and insulation.
2&3 Local farmers acted as subcontractors.
3&4 Material sourced for siding and decking came from lot within view of site and was stored in neighbour's barn until installation.



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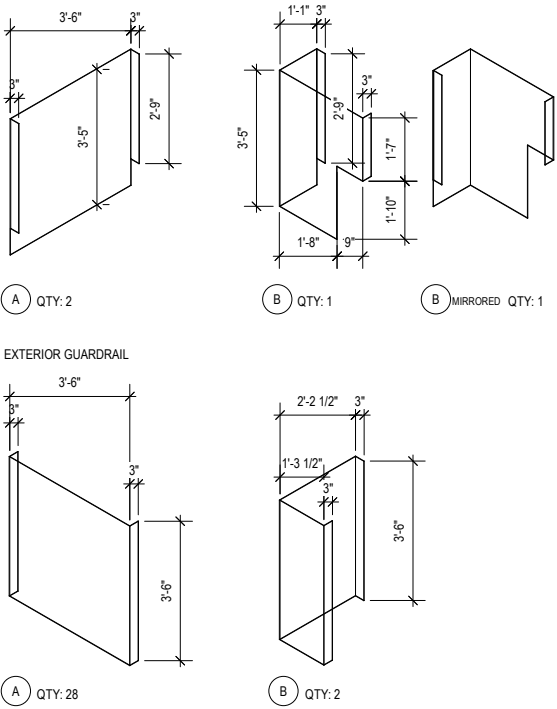
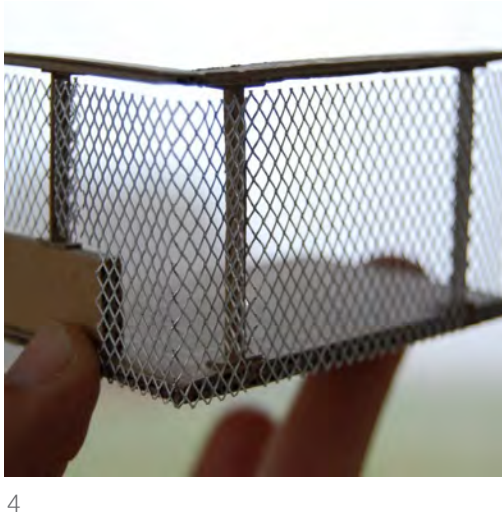


A local farmer and electrician, Ken Shortreed, brought his bucket truck and his family to help out. Another acquaintance who fixes farm machinery fabricated and installed the exterior guardrails and steel mesh panels on the mezzanine sitting room. “That was how things went,” Treanor says. “Many of the workers did jobs they never knew they had talent for, jobs they’d never done before.”

‘Into the Great Wide Open,’ Dwell Magazine, November 2012, Alex Bozakovic.

Local steel agricultural materials and implements were recycled and/or reappropriated. Steel grating typically used for barn walkways were brake-formed into interior and exterior guardrail panels. A number of interior elements such as steel bases for kitchen counters and perforated hammermill screens for filtering grain, reappropriated into a hanging “pulley” light shade, were reclaimed from a local recycled steel yard. Steelwork was completed by a local farmer with a side trade as a steelworker with the author acting as “apprentice” on site.

- 1 Steel barn walkway grating used for guardrails.
- 2 Steel “pulley” light, constructed from two hammermill screens.
- 3 Hammermill screen reference image.
- 4&5 Basic models and axonometric drawings served as basic communication tools with the subcontractor.
- 5 Spike Bakker, farmer/steel worker.
- 6 Completed interior Photo showing range of reappropriated steel elements.
- 8 Completed exterior photo of deck walk.



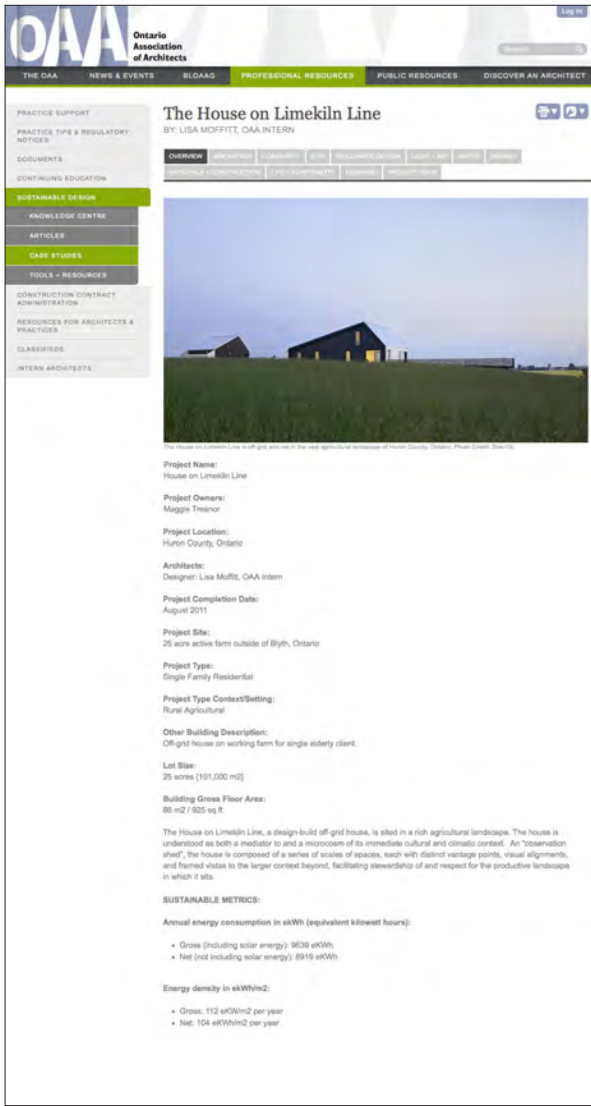
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The house has been recognised on a local, national and international context professionally, academically and to the general public. The Ontario Association of Architects presented the project as the first case study of exemplary sustainable design on their professional website. The OAA is the professional governing body of architects in Ontario with 5,000 members.

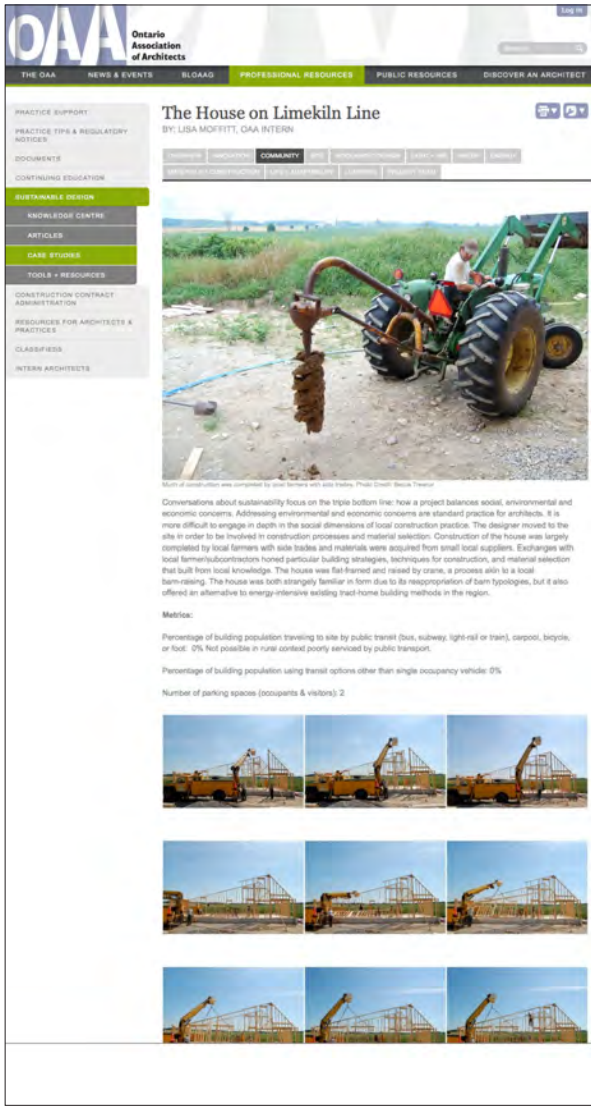
Research associated with the house has been integrated into the curriculum of two Universities in Canada: it is a case study project and featured as a site visit for students of Ryerson University. Fanshawe College in London, Ontario included a video interview with the author as part of their 'Applied Sustainability' MOOC.

The project has featured on many design websites including, among others: ArchDaily, the most widely read architecture website in the world, Dezeen, inHabitat, Archilenta (in Russian), Thisispaper, the Ruralist, Treehugger, ARQA (Argentinian), and Architizer.

Sources:
1 <http://www.oaa.on.ca/professional%20resources/sustainable%20design/case-study-details/preview/12>
2 <http://www.ruralist.ca/see-an-off-the-grid-home-in-huron-county/>
3 <http://www.archilenta.ru/index.php?act=1&catg=72&nwid=2278>
4 <http://www.dezeen.com/2013/02/20/house-on-limekiln-line-by-studio-moffitt/>
6 <http://thisispaper.com/Studio-Moffitt-House-on-Limekiln-Line>



1 Professional Governing Body Website, Canada



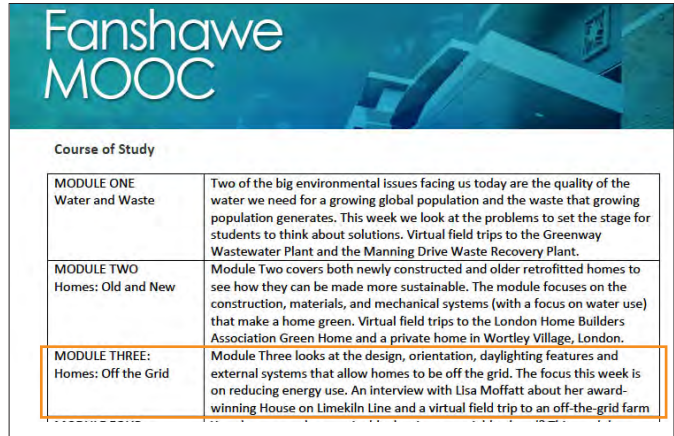
2 Local Community Website, Canada



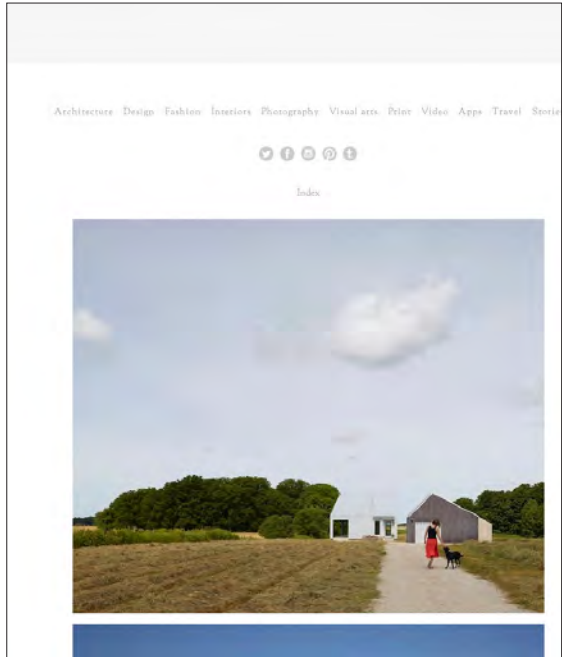
3 Design Website, Russia



4 Design Website, United Kingdom

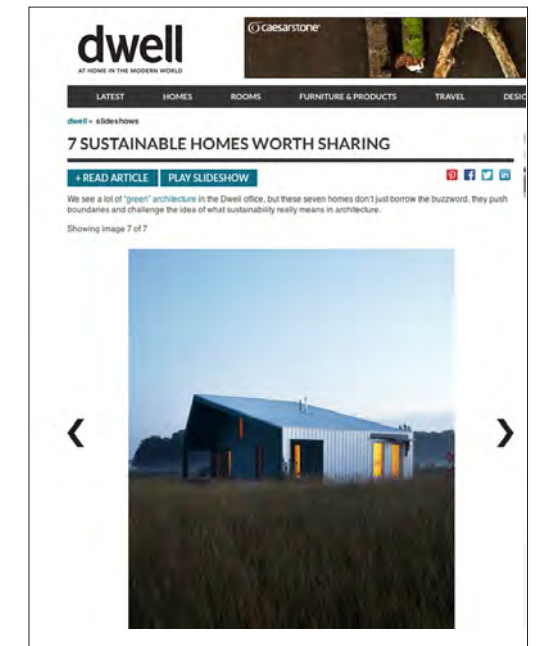


5 Fanshawe College 'Applied Sustainability' MOOC curriculum, Canada



6 Design Website, Japan

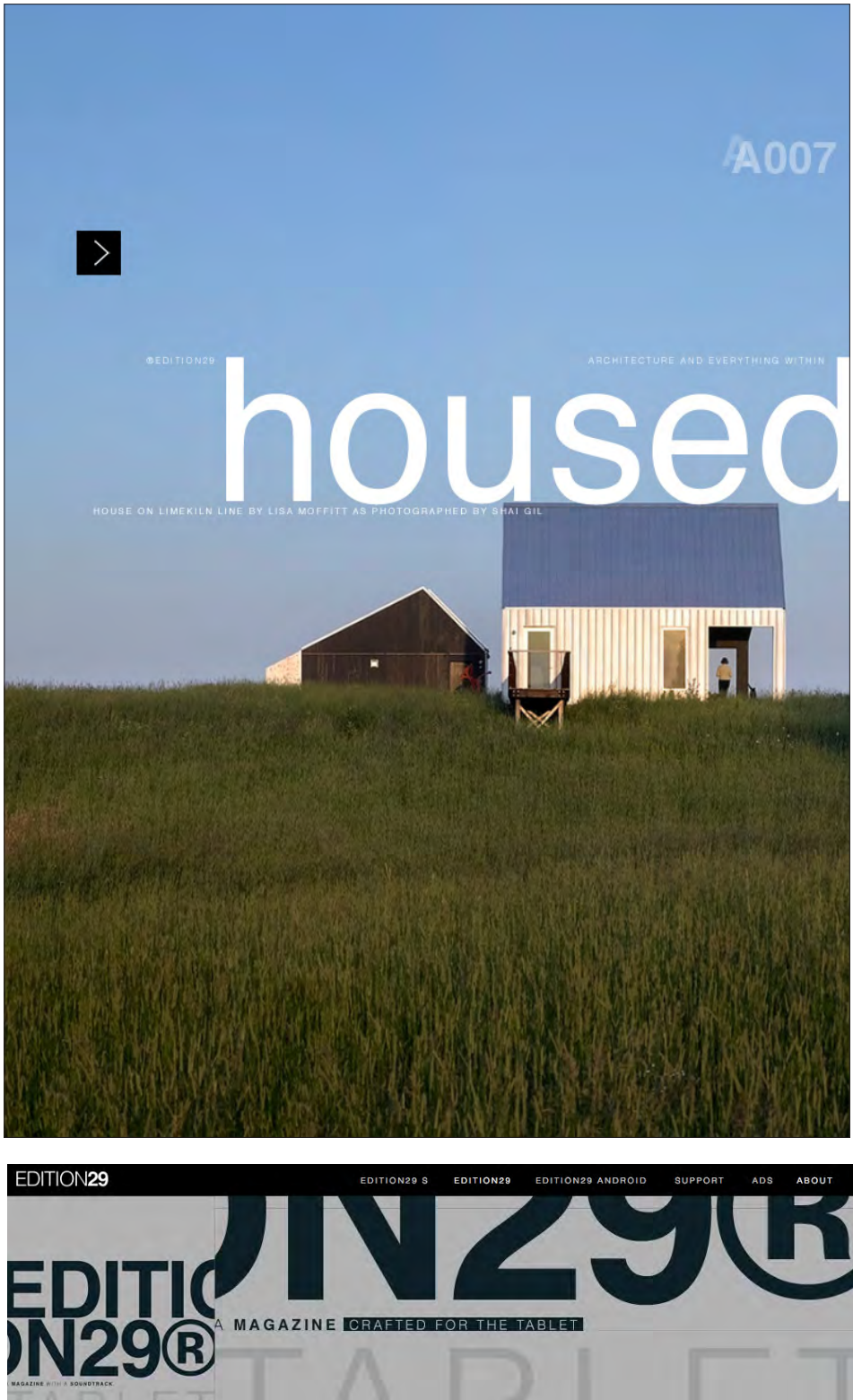
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- 1** dwell.com
August 2012



⁷Dwell Magazine Online. Source: <http://www.dwell.com/great-idea/slideshow/7-sustainable-homes-worth-sharing#7>

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In Spring 2013, the house was the cover feature of issue 007 of the international design tablet magazine Edition 29, which includes designer audio interviews. It was selected by HISE, Slovenian Design Journal, as one of the best homes of 2013 and was subsequently exhibited in Ljubljana.

Selected spreads from Edition 29 Magazine.



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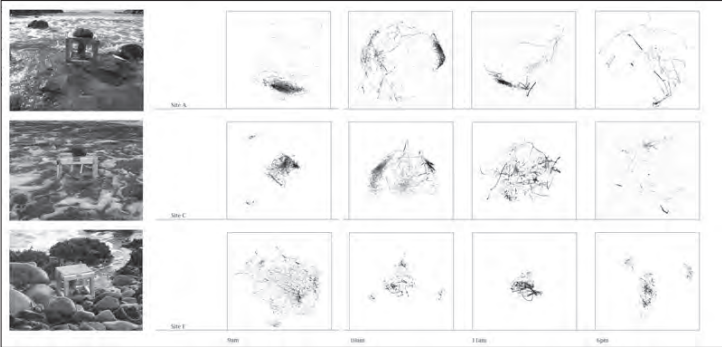
Techniques honed and questions raised through this research has informed current teaching and continued research.

From 2010-present, four third year design studios have researched how qualitative and quantitative understandings of environmental conditions inform design of *passive* buildings within *active* landscapes of cultivation in the exposed weather-beaten Scottish Islands of Kerrera and Rhum. The studios have equipped students with both an experiential understanding of environmental conditions while also introducing a range of representational strategies for designing strategically to maximise environmental performance.

A collaborative research project with Heriot Watt University tested how environmental modelling techniques using computational fluid dynamics inform understanding of specific microclimate conditions on the active landscape of Fresh Kills Landfill. The design proposal, an Exothermic Landscape, makes legible and amplifies these environmental phenomena where weather 'fronts' meet: where heat meets cool, static meets sway, turbulence meets calm. Current research continues to test the relationship between environmental modelling techniques, fieldwork methods and representational strategies of environmental performance.

PEDAGOGY

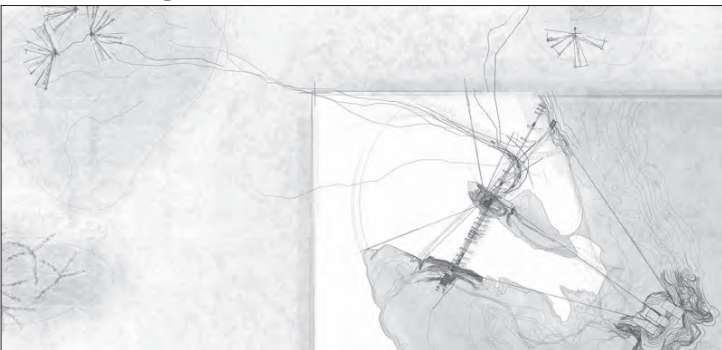
Measuring Environment



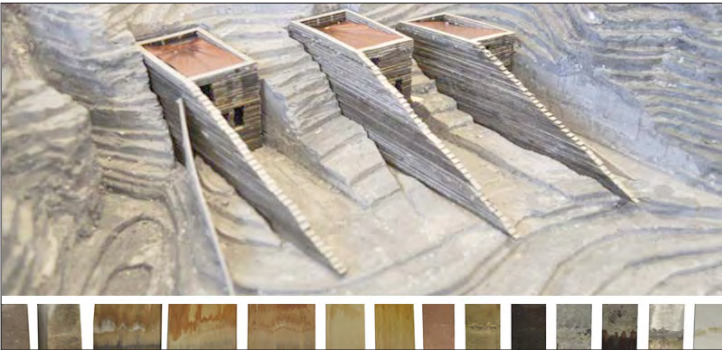
Mediating Environment



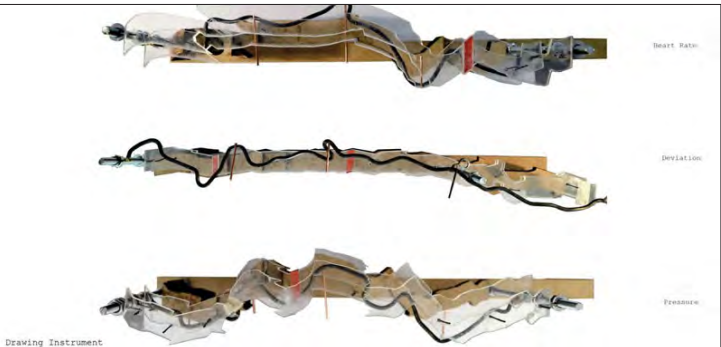
Active Landscapes



Passive Building

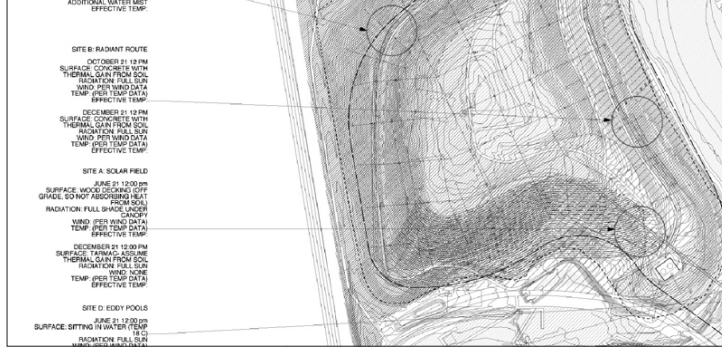
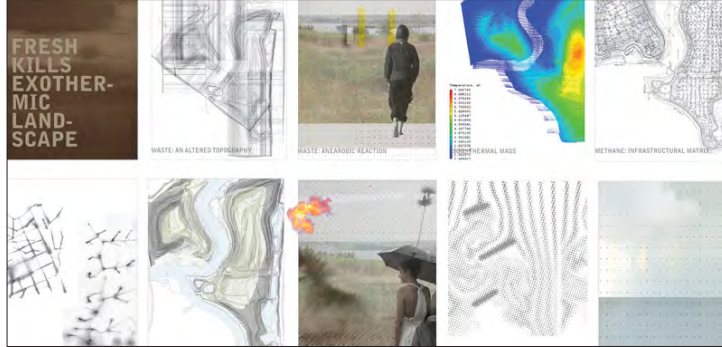


2011 Third Year Design Studio, Drawing Energy Kerrera 1: Thomas Fern, Rob Hebblethwaite and Hayden White



2012 Third Year Design Studio, Drawing Energy Kerrera 2: Laura Bray and Chiara Fingland

COLLABORATIVE RESEARCH



Exothermic Landscape: Fresh Kills Landfill Competition Entry. Collaborators: Marie Estaban (ESALA student), Dr. Fan Wang (Heriot Watt University), Alastair Patterson (Heriot Watt Student)

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